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IMPROVED ELECTRIC LOCK & BLOCK SYSTEM

Style L, Type B

SAXBY & FARMER (INDIA) LIMITED

17, Convent Road, Entally

CALCUTTA

Telegrams: "INTERLOCK, CALCUTTA"

Telephone: 171-172 CALCUTTA

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MAY, 1923

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Introduction

IN presenting this pamphlet for the consideration of Indian Railway Officers, describing our latest type of Lock and Block system, we think it may prove useful if we offer a few preliminary remarks upon lock and block working in comparison with the ordinary block telegraph.

With the block telegraph the security rests entirely upon the strict observance of the rules by the signalmen and their interpretation of the bell signals and other indications provided for their guidance. Nothing compels them to work their fixed signals in accordance with the block indicators, nor prevents them from operating the block instruments without regard to the actual conditions of the section of line concerned. A moment's forgetfulness may easily lead to a serious accident, as experience has repeatedly proved. Moreover, when such a mishap does occur, it is very difficult and sometimes impossible to establish which of the signalmen involved was at fault, for the apparatus being free to be worked exactly as the signalmen please, it cannot be known afterwards, in many cases, what has actually taken place. Although the rules are drawn up, and the apparatus constructed, so as to make it as difficult as possible for an error to pass undetected, in the last resort the security of the system rests upon the care and vigilance of the signalmen.

To remedy the defects of the block telegraph and to reduce the risks arising from human fallibility to the smallest amount possible is the object of Lock and Block, which is also known as Interlocking Block or Controlled Manual Block. With it the block instruments and the levers in the interlocking frame are interlocked, either electrically or by electro-mechanical means, so as to compel the signalmen to operate them in a predetermined manner, making it impossible for the signals to be left permanently in the CLEAR position, or put to that position, unless the block indicators show that this is permissible. In addition, control is provided so that TRAIN OUT OF SECTION cannot be given until the train concerned has arrived at the signal cabin in advance and passed over an electric treadle or rail contact (sometimes working in conjunction with track circuit), this, in turn, unlocking some part of the block apparatus. In this way the possibility of mistake is reduced to a very small quantity, and it is easy to decide which signalman is at fault should an accident occur. The advantages of lock and block are peculiarly evident where it is necessary to employ native signalmen, who cannot be relied on to the same extent as can the signalmen employed on European railways.

Several systems of Lock and Block have been designed, but the system which has been most used on English and Colonial lines is that of Sykes, the first installations of which were made as far back as 1875, and its operation has given general satisfaction.

The development of track circuiting and other electrical apparatus has led since to modifications in the theory of lock and block working. Formerly it was the custom to endeavour to cover, as far as could be, all the traffic movements likely to occur either in a block section or within interlocking limits, and on some suburban sections this was carried out very completely. Track circuiting has provided a more satisfactory means of protecting movements generally, but especially within interlocking limits where the partial and irregular character of such movements leads to the frequent use of the cancelling key or equivalent resetting apparatus. The disadvantages of having to employ a means of resetting by hand, though often greatly exaggerated, are, nevertheless, real, and, where shunting movements occur, frequently leading to its general use, the security of the lock and block apparatus tends to become impaired.

When the principal installations of the Sykes system were constructed, track circuiting was practically non-existent in Great Britain, and such as existed was put down for the most part by the late W. R. Sykes for special or experimental purposes.

The lock and block system reached its most complete form in the Sykes apparatus, and the success it attained formed a striking testimony to the soundness of the principles on which it was built up. In the original system, the connection between the interlocking gear on the signal and point levers and the block instruments was effected mechanically by rods, which necessitated rather careful fitting, and the fixings often had to be built to suit the particular type of locking frame to which the apparatus was to be attached. Further, knowledge of a rather special character was needed to enable the fitting to be properly done. Moreover, many engineers did not like the mechanical method of effecting the interlocking between levers and block instruments.

We have therefore developed a lock and block system available for use in conjunction with track circuiting, and involving no mechanical connections between the block instruments and the locking frame. This system, known as the style L, type B, has been designed in conjunction with Messrs. W. R. Sykes Interlocking Signal Co. Ltd., of Clapham, London, whose long experience with lock and block, and complete knowledge of the various systems hitherto employed are well known. We are thus enabled to offer the new system in full confidence that it will meet the most exacting requirements.

Track circuit control can be added to the style L system without any alteration to the block instrument. It is only necessary to make the required electrical connections, which can be done in a few minutes.

IMPROVED ELECTRIC LOCK AND BLOCK SYSTEM

Style L, Type B

IN this system no attempt has been made to cover train movements within interlocking limits, as, for the reasons already mentioned, we consider it distinctly preferable to use track circuit for this purpose. The system is entirely electrical, no rods or other mechanical connections between the block instruments and the locking frame being required. The instruments can be placed in any convenient position, even in a building apart from the levers, such as the Stationmaster's office, often desirable on Indian railways and other lines where traffic is light. The system is a three-wire one, and employs three-position block indicators, in accordance with the best English practice.

Three Wires v. One Wire.—As the question of three-wire *v.* one-wire block working is an important one in the selection of a system, we think it may be useful to make a few remarks here upon it and explain our reasons for adopting the three-wire arrangements for the style L system. The adoption of three-position block indicators needs no justification, as experience everywhere has shown that they are much superior to two-position indicators, which cannot be worked consistently so as to avoid ambiguous indications unless the line is worked on the NORMALLY CLEAR principle, which does not meet with favour among those who follow British practices in traffic working.

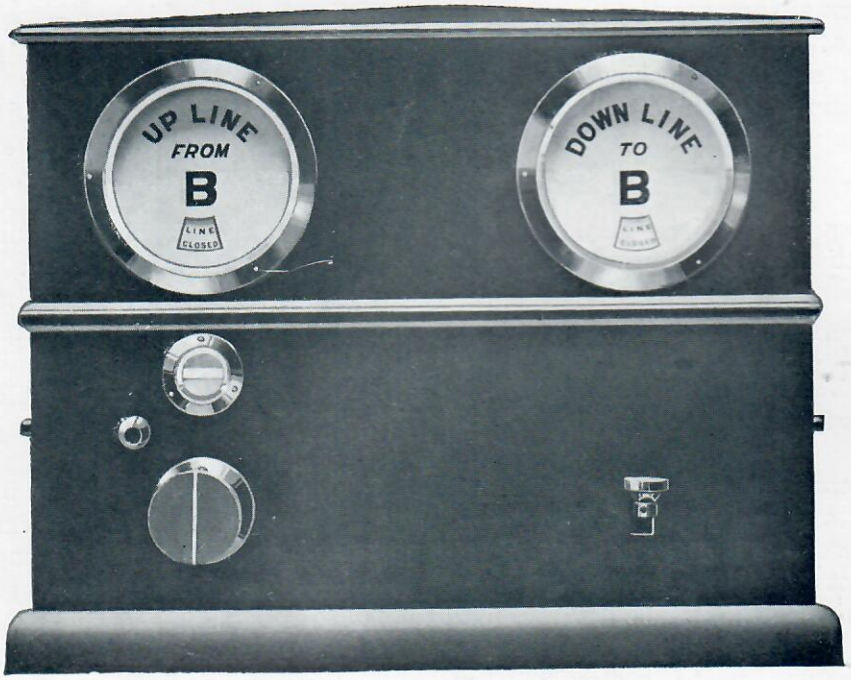
With the one-wire system the block working for both directions and the bell signalling are conducted over one and the same line circuit, with the result that, should an interruption occur, everything is thrown out of service. Further, as intermittent current must be employed, the block indicators do not themselves indicate a line fault, and must remain in whatever position they may happen to be in when the trouble develops until the fault is put right. This position may be LINE CLEAR, which cannot be regarded as satisfactory. To obtain three-position block indicator working with the one-wire system, it is necessary to employ two strengths of line current, and the difference in current value must be accurately maintained, or there is danger of false block indications being given. This creates difficulties where cabins have to be switched out.

With the three-wire system the UP and DOWN circuits and the BELL circuit are quite separate, and there is, therefore, much less chance of a total breakdown of communication. The circuits are simpler, and it is not necessary to employ any difference of strength in the line current in order to obtain three distinct indications. The important indications of LINE CLEAR and TRAIN ON LINE can be maintained by constant, though very small currents, and a failure only results in LINE CLOSED being indicated.

In addition to this, when a single-line wire is used it becomes impossible, without employing very complicated apparatus, to obtain controlled cancellation, automatic indication of TRAIN ON LINE, and other valuable features which our new system embodies, and it is unnecessary to emphasize to Indian Railway Officers the paramount importance of employing the simplest circuits and apparatus possible.

Therefore, although a one-wire system is in some respects cheaper than a three-wire system, we have no hesitation in saying that the additional facilities and simplicity which the latter offers more than compensate for the additional wires between stations, especially as with the style L instrument it is not always necessary to erect a separate wire for the bell communication, as if a telephone or telegraph circuit already exists, the bell working can be superimposed on it.

The Style L Block Instrument



IN the standard form illustrated, the UP and DOWN Block Indicators, the Bell Key, and the Bell Mechanism are all combined in one case, making a very convenient and compact arrangement, but separate cases can be provided if desired. The Block Bell and the Alarm Bell, used to remind the signalman when he has failed to make some movement which he ought to have made, are at the back.

The instrument is constructed so as to give easy access to all the working parts, which are mounted on the base and back plate of the case. The front and sides of the case are removable by taking out four screws, the heads of which are shaped so that they can be locked in position by means of a bar and padlock.

The relays are built in accordance with the latest practice, and can be removed as a complete unit, being held by three screws to the back of the case.

The magnet coils can be easily changed without dismantling any other portion of the relays.

The indicators are of the Spagnoletti needle type, and may be disconnected and removed from the instrument in a few seconds. A flag, suitably counterbalanced and painted, gives the three indications.

The electric lock controlling the commutator handle is of light but strong design, and could not possibly be forced or jumped.

The leading-in wires are taken through holes at the top of the back plate directly on to a terminal board running the whole length of the instrument, suitably lettered to facilitate wiring and testing.

The block bell and relay are mounted on a cast brass plate, which is insulated from the back of the main case on which it is mounted. Blinders are provided to cover the holes in the case for the bell striker and the ringing key.

The alarm bell, which is totally enclosed and cannot be interfered with, is carried separately behind the main case. It is equipped with a large gong and gives very powerful signals.

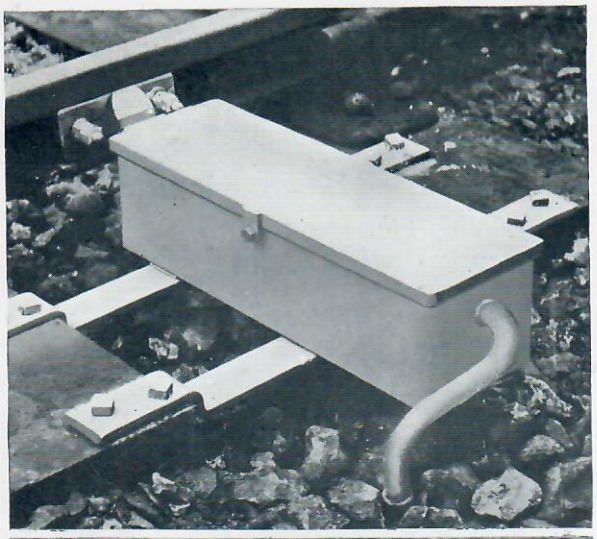
The insulating material used in the instrument is a special composition known as " Hightensite." In appearance it is very similar to fibre, but it has the great advantage of being non-hygroscopic, and is unaffected by extreme changes in temperature, rendering it particularly suitable for use in India.

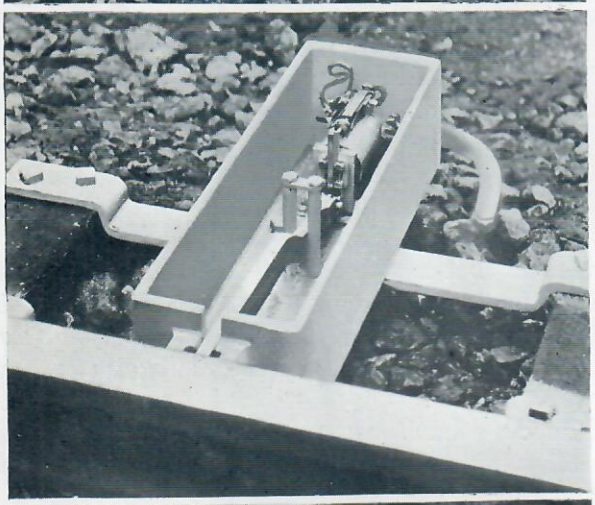
The instrument can be operated by one battery of sixteen Leclanché cells, but it is advisable to work the small local circuits from a separate source of lower voltage, in order to obtain a uniform discharge of the battery, and thus effect economy. It is built up of standard parts that have been used under different circumstances for many years, so that, while the method of combining them in the style L instrument is new, the actual operation of them has been well tested in other apparatus.

As illustrated, the whole of the instrument is seen, so far as it concerns the signalman, in its normal condition with no train signalled. The right-hand dial relates to departing trains, and is placed over the Bell or Ringing Key which is used to give code signals to the next block station. The left-hand dial relates to arriving trains. Beneath it is placed a smaller dial, called the Treadle Indicator, and below this the combined Commutator and Plunger, used for operating the block indicators for that section. Its movement being controlled by an electric lock, a small push button is provided to close the circuit to it and to the lock controlling the cancelling button on the right-hand end of the case. Another cancelling button is provided at the left-hand end.

The instruments are made either for left or right hand, one of each type being required for an ordinary double-line block station.

Electric Treadle





THE treadle which we have designed for use with this system employs a direct spring contact in preference to mercury.

It is carried by steel straps on the sleepers, and is made in three styles, viz. :

Clearing ;

Locking up ;

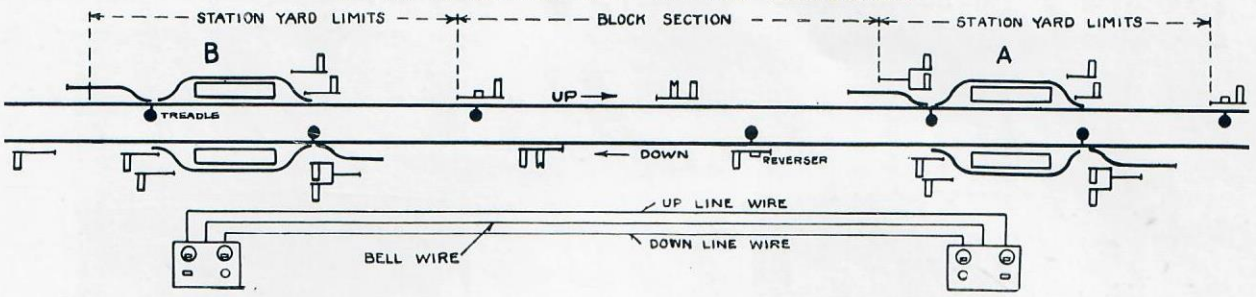
Combined clearing and locking up.

When a clearing effect is required, the control coil seen in the middle picture (Wood's Patent, No. 113520) is provided, and has for effect to cause the circuit to remain closed until the block instrument has been released and the home signal replaced, thus avoiding the troubles which are often experienced with light engines passing rapidly over a treadle, and giving too short an impulse.

Special apparatus to produce the "last-vehicle" treadle effect can be provided if required.

Arrangement of Instrument, Signals, Electric Treadle, etc.

FOR A STATION WITH SIDINGS



Apparatus required for UP and DOWN sections.

2 Block instruments.
4 Treadles.
2 Lever locks, with catch-handle contacts.
8 Contact boxes (Starter and Home levers).
2 16-cell Leclanché batteries.
2 Reversers.

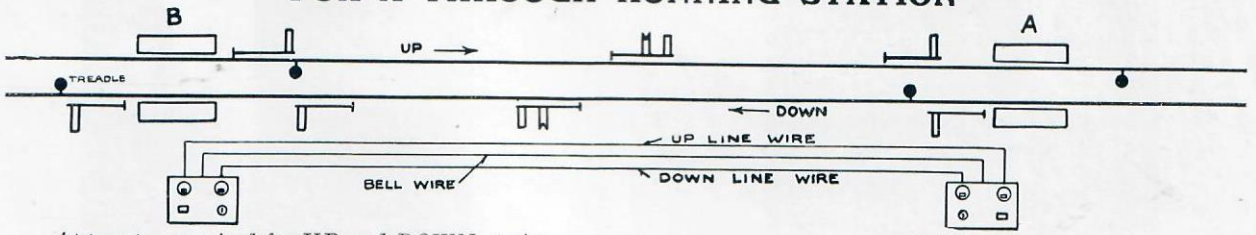
NOTES.

1. Starter signal unlocked only when LINE CLEAR is given.
2. Starter signal reversed when train passes over treadle at entrance of section, and is then locked.
3. Block instruments released when train passes over clearing treadle and home signal is at DANGER.
4. The bell line wire may be arranged to work on the telegraph line between stations, and then only two extra line wires would be required for the block instruments.

AN electric treadle is fitted just beyond the advanced starting signal, for replacing that signal to danger and causing the TRAIN ON LINE indication to appear at each end of the section, if the signalmen have failed to do so by the time the treadle is reached. A second treadle, called the "Clearing Treadle," to distinguish it from the "Locking-up Treadle," is placed at a convenient point inside the home signal, and, when operated, changes the treadle indicator and unlocks the block instrument for the section in the rear.

The control on the signals is obtained by equipping the advanced starting signal with a reverser and an electric lever lock, the latter being released when the LINE CLEAR block indication is showing, and the train has therefore been accepted by the block station in advance.

FOR A THROUGH RUNNING STATION



Apparatus required for UP and DOWN stations.

2 Block instruments.
2 Treadles.
2 Lever locks, with catch-handle contacts for starter signals.
6 Contact boxes (Starter and Home levers).
2 16-cell Leclanché batteries.

NOTE.

Reverser fitted to commencing section Starter. Train must pass over treadle before previous section is released, and Home Signal and Starter at the station must be at danger before LINE CLEAR can be given again.

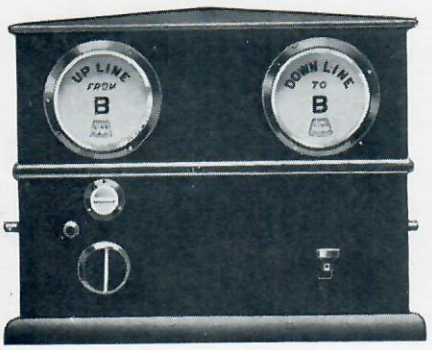
In this case it is only necessary to use one treadle, placed beyond the starting signal, which performs the double function of clearing the section in the rear and locking up the section in advance. Each starting signal would be equipped with an electric lever lock, but only one reverser would be required on the first starting signal of the series. At the other stations the block instrument would be so controlled that LINE CLEAR cannot be given unless all the signals for the line concerned are at danger. In addition to this, if the starting signal be left in the CLEAR position, the alarm bell set in action by the locking-up treadle will continue to ring until the signal is replaced to danger.

Process of Signalling

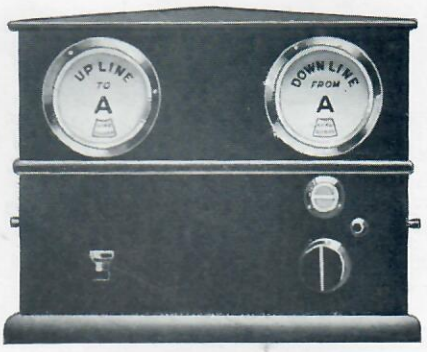
TO explain this we may assume two stations, A and B, with a train requiring to travel from A to B :

1. Normal condition of the instruments.

A



B

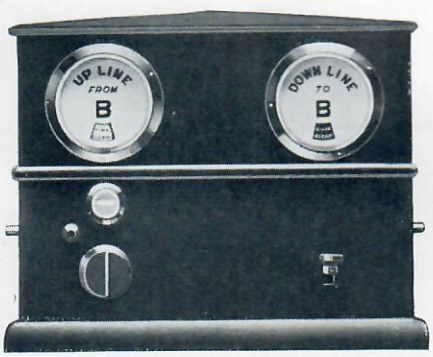


The block indicators show LINE CLOSED and the treadle indicator a white bar.

2. A gives the IS LINE CLEAR signal to B, who, if prepared to accept the train, depresses his signalling commutator for a few seconds and then releases it, when it becomes locked.

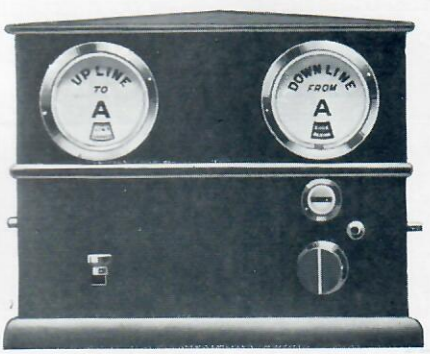
The instruments appear thus :

A



The block indicator shows LINE CLEAR, and starting signal is unlocked.

B



Block indicator shows LINE CLEAR, treadle indicator a red bar.

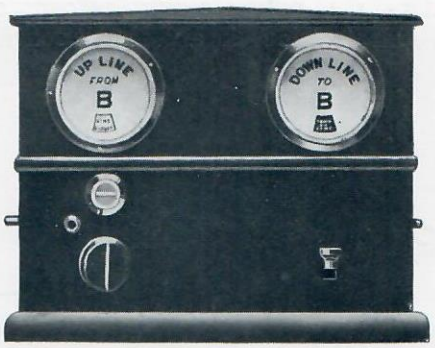
3. Starting Signal at A is pulled off ready for the train.

4. Train starts from A.

5. A gives the TRAIN ENTERING SECTION signal to B, who acknowledges it and turns the signalling commutator to the left.

The instruments now show :

A



Block indicator—TRAIN ON LINE.

B

Block indicator TRAIN ON LINE, treadle indicator a red bar.

NOTE.—*If operation five is carried out before the train reaches the locking-up treadle at A at the entrance to the section, as it usually would be, the alarm bell is not sounded at B, but should the treadle be actuated while LINE CLEAR is still exhibited, the indicators will be placed automatically to TRAIN ON LINE, and the bell will ring at B until the commutator there is placed in the corresponding position. The TRAIN ON LINE signal, once shown after LINE CLEAR has been given and the locking-up treadle has been actuated, cannot be cancelled until the train leaves the section. At A the alarm bell rings directly the locking-up treadle is actuated and until the starting signal is replaced. The starting signal at A is free to be put back to danger and pulled off again any number of times after LINE CLEAR is indicated until the locking-up treadle is operated, but it becomes relocked if the train is cancelled.*

6. The train passes through the section, and on arriving inside the home or starting signal, as the case may be, at B, actuates the clearing treadle, causing the instrument there to appear thus :

The treadle indicator again shows a white bar, but the block indicator continues to show TRAIN ON LINE. The alarm bell commences to ring, and continues ringing until the signal is replaced behind the train.

7. B, after replacing his signals to danger, turns the Signalling Commutator to its normal position, and both instruments reassume the condition shown in Stage 1. At the same time B gives the TRAIN OUT OF SECTION signal. Another train may now be sent forward from A by repeating the above procedure. A similar series of movements is required to send a train from B to A.

8. If B should require to give the blocking back signal to A he turns the signalling commutator to the left, and the block indicators at both cabins show TRAIN ON LINE, but the treadle indicator at B remains white. The TRAIN ON LINE indication can be given and removed at will as long as LINE CLEAR has not first been given.

Points and Junction Locking

TO interlock points with the block instrument, or two or more block instruments with one another to prevent conflicting movements taking place at junctions, it is only necessary to connect the instruments in the correct way and to provide the point levers with electric locks and circuit controllers.

Cancelling

IT has always been considered as a weak point in Lock and Block working that it is necessary to provide some means of resetting the block instrument independently of the train, to meet the case of a train which has been accepted but does not have to proceed for some reason or another, owing to the liability of such an arrangement being misused. This difficulty has been apparent in all lock and block systems hitherto, and several suggestions for overcoming it have been put forward.

In the style L system the problem is solved by adopting the principle that, provided both the signalmen concerned agree to do so, the block instruments can be returned to the normal position at any time until a train actually enters the section. However, it is impossible to cancel with a train in section, and thus the danger of misuse of the cancelling apparatus is entirely eliminated. Moreover, since the signal at the entrance to the section can be pulled off and replaced to danger freely while LINE CLEAR is indicated, the amount of cancelling required is reduced to a minimum. It will be remembered that TRAIN ON LINE becomes automatically shown (if not already exhibited by the action of the signalman) directly this signal is passed, and from that moment the lever becomes absolutely locked if replaced to the danger position.

In the style L system cancelling is effected by the two signalmen involved pressing simultaneously on buttons provided at the side of the block instrument, this action causing the treadle indicator to change from red to white. The button at the entering end of the section is controlled by an electric lock, and it cannot be used unless the signal governing the section is locked at danger and no train has passed it. Once the train reaches the locking-up treadle, cancellation becomes impossible.

It will be seen that the block instruments cannot be reset to normal if the clearing treadle fails to act when the train leaves the section. This is, in our opinion, correct practice, and in line with that adopted with track circuiting, where, when a circuit breaks down, trains have to be hand signalled till the fault is rectified. The adoption of this principle has enabled us to solve completely the cancelling problem in lock and block.

Where point interlocking, or interlocking between different block instruments, exists, the failure of the clearing treadle might cause an unnecessary and serious dislocation in the traffic working ; in such cases we recommend the provision of some emergency apparatus to cancel the locking on the levers concerned, but in no circumstances to release the particular block instrument to which the defective treadle applies, thus keeping rigidly to the principle of non-cancellability after a section has been entered by a train.

Alarm Bell

THE Alarm Bell performs an important and novel part in the style L system. Its purpose is to remind the signalman to operate his instrument in the proper manner at each important stage in the process of signalling a train. It works as follows :

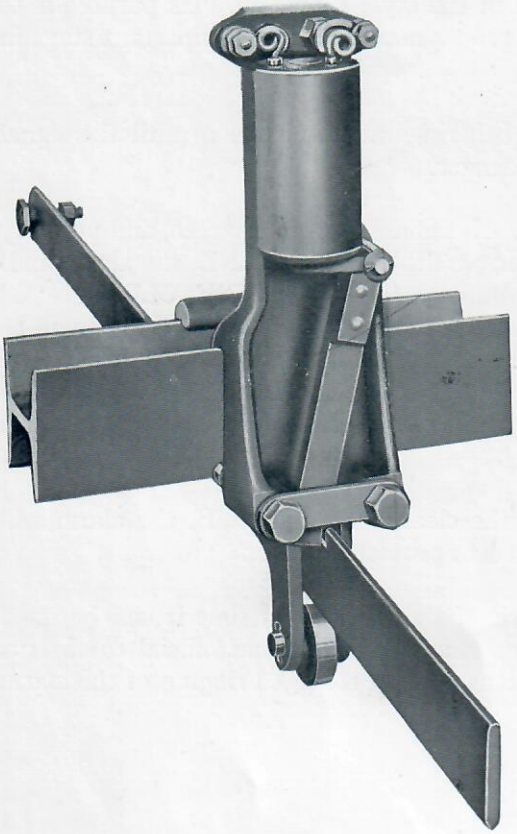
When a train passes the locking-up treadle at A the bell rings at that station until the signal governing the entrance to the block section is replaced at danger.

If, before this occurs, the TRAIN ENTERING SECTION signal has been given to, and properly acknowledged by, B, the block indicators having been placed at TRAIN ON LINE, the alarm at B will not be sounded, but should the train reach the treadle while the indication LINE CLEAR is still showing, the indicators will be placed automatically at TRAIN ON LINE and the bell at B will be set ringing. To stop the alarm the signalman at B must turn the commutator to the TRAIN ON LINE position. If the signalman should attempt to release the TRAIN ON LINE indication before the train arrives at B, the only effect of turning the commutator back will be to set the alarm ringing again, the indicators remaining unaffected.

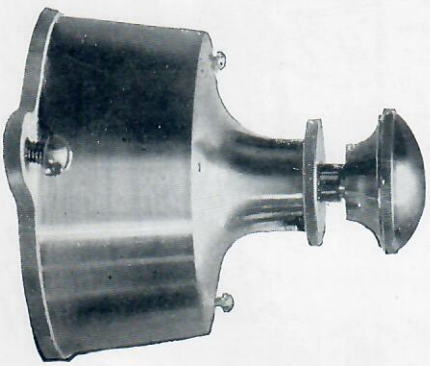
When a train passes out of the section and operates the clearing treadle at B, the alarm will sound at that station until the home signal has been replaced to protect the train.

The usual practice is to fix the alarm bell on the back of the instrument, but it can be fixed separately if desired, as, for instance, in the Stationmaster's office, enabling that official to observe whether the signalmen are working up to the block regulations. Any prolonged ringing of the alarm would indicate inattention.

Apparatus



Lever Lock, style A.



Shelf Plunger.

Catch-Handle Contact, method of application.

Apparatus

IN addition to the block instrument and electric treadle already described, the following parts are included in the style L system :

LEVER LOCK, Style A

This is very strong and simple in construction and may be fitted also to point levers, when these require to be interlocked with the block instrument.

CATCH-HANDLE CONTACT

For closing the local lock circuit, so that the lock shall be energized only when required.

SHELF PLUNGER CONTACT

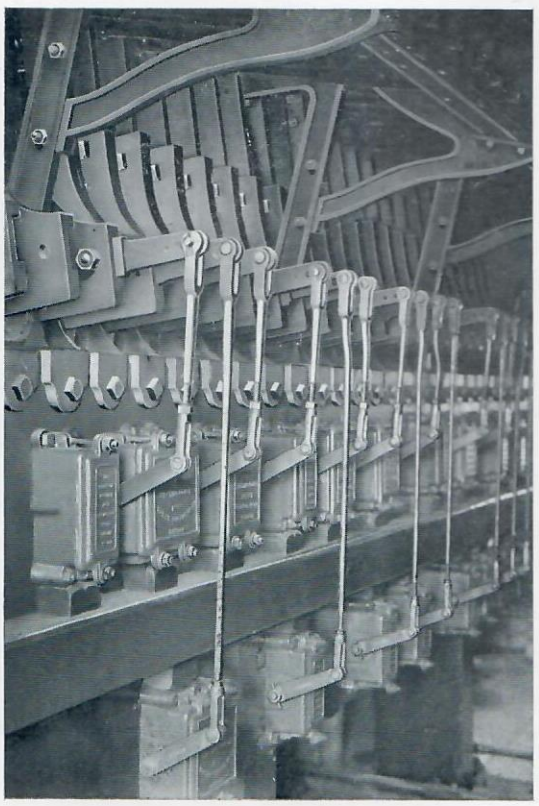
Alternative to catch handle contact, if desired.

LEVER CIRCUIT BREAKER OR SWITCH

Shown attached to a mechanical locking frame. The contacts can be arranged to suit different combinations of circuits, according to the requirements of any particular scheme.

SIGNAL REVERSER, Style A

Shown fitted in the up and down rod of a signal. Other types of reverser can be supplied, designed to go either directly on the arm spindle or to be fixed to the post.



Lever Circuit Breakers connected to levers of a mechanical frame.

Signal Reverser, style A.

Conclusion

THE style L system forms a complete Lock and Block system for sectional protection, and provides the three standard indications, LINE CLOSED, LINE CLEAR, and TRAIN ON LINE, which long experience on British railways has shown to give excellent results. It can be arranged to meet all the requirements of manually worked block signalling.

The block instrument is very compact and easy to work and understand. It can be placed in any convenient position in the signal cabin, being only connected electrically to the apparatus on the signal and point levers. It can be readily combined with track circuit locking and inter-block instrument locking, by simply making the necessary electrical connections. It is the result of many years' experience in lock and block working, and the mechanism has already been proved by prolonged service to be thoroughly reliable.

The automatic TRAIN ON LINE signal and alarm bell apparatus, combined with the control of the cancelling, render the style L system peculiarly suitable for working under the severe conditions applying in India, where it is necessary to take the fullest possible precaution against mistakes and carelessness.

Circuit diagrams and more detailed information will be sent to any responsible railway official on request.

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IMPROVED ELECTRIC LOCK & BLOCK SYSTEM

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